Appendix I. Equivalent Buffer Area Index (EBAI) Methodology

The equivalent buffer area index was devised as a crude assessment of risk for streams in relation to management activities. It is similar in concept to the equivalent road area (ERA) analysis of McGurk and Fong (1995) and the non-point source risk assessment of Lull and others (1995). However, while those studies developed an method to assess sediment contribution from management activities, the EBA is relative measure of the protection of streams *from* fine sediment derived from hillslope erosion and from road surface erosion. Because the literature usually evaluates buffer widths based on no harvest, and most of the alternatives have some activity within the buffers, the recommended buffer widths in the literature are not directly comparable to the those in the alternatives.

The EBA provides a structure to take into account the management activities within the buffer zone. It combines the impacts of activities within the riparian management area (RMA) on the effectiveness of the RMA at filtering sediment. In addition, because buffer requirements for sediment filtration are more stringent than buffer requirements for protection stream temperature and large woody debris recruitment (Johnson and Ryba 1992), the EBA can also be used to compare relative protection for those parameters as well.

The EBA cannot be used to compare the effectiveness of various management plans on protection against sediment from road/stream crossing failures or from debris flows. These sediment sources are generated within the riparian zone, and as such cannot be filtered by any width of buffer. Stream bank stability cannot be assessed solely with the EBA, since management-induced changes in hydrology may affect lateral stream erosion, which decreases stream bank stability.

As in the ERA, this method uses coefficients assigned to various timber management practices based partly on the literature (including the figures and tables in the RMZ literature survey in the SYP) and partly on professional judgment. This reflects the relative ranking of these silvicultural practices presented in Lull and others (1995). In that study, a coefficient matrix was developed use the Delphi technique, which used a panel of experts in riparian impacts of timber harvest to assign values based on collective professional judgment.

The highest coefficient used is 1.0, representing no harvest, which is the highest amount of protection. Any activity within the RMZ that removes trees or disturbs the soil reduces the coefficient. The relative impact of various activities was used to assign the coefficients. In addition the silvicultural system used (clearcut or selective harvest) was used to refine coefficients. A further refinement was made based on the relative number of trees left in the RMZ. The attached table shows the coefficients used and the reasoning behind them. The lowest coefficient was zero, which is assigned to tractor logged clearcuts, the most damaging practice.

Unless otherwise specified, the harvest method was determined based on the FPRs, which use 50 percent slope as the limit for tractor logging.

The EBA index is calculated by multiplying the management coefficient by the width over which it is applied. Where multiple activities occur in the RMZ, the products of coefficient and width for each activity are summed. The EBA index ignores activities that overlap or cross multiple management areas (e.g., grazing), since these appear to be consistent among the alternatives. However, these could be included later.

Ultimately, the index incorporates effects to all streams, regardless of class, into a single number for each hydrologic unit. This is done by multiplying the sum of the coefficients (see equation below) by the length of the stream miles associated with that class. Then the results for each stream class are totaled. If a watershed has multiple owners with different RMA management activities, these can be accounted for.

$$EBA_i = [(w_1*C_1) + (w_2*C_2)+ (w_x*C_x)]\ R_I + [(w_1*C_1) + (w_2*C_2)+ (w_x*C_x)]\ R_{II} + [(w_1*C_1) + (w_2*C_2)+ (w_x*C_x)]\ R_{III}$$

where i = Hydrologic Unit i

w_1= width of management activity 1

w_2= width of management activity 2

C_1 = activity coefficient 1

C_2 = activity coefficient 2

R_I = total length of class I streams

R_{II} = total length of class II streams

R_{III} = total length of class II streams

Alternatively, the EBA can be used to compare between alternatives the amount of protection given to each stream class.

Class I streams	Base width (ft)	Palco Lands Band 1 Practice	Width of Practice	Coefficient*	Band 2 Practice	Width of Practice	Coefficient*	Band 3 Practice	Width of Practice	Coefficient*	Effective Buffer Index	Stream Miles	Area Index (mi2)
Alternative 1													
Class I streams	340	No harvest	340	1							340	22.7	1.46
Class II streams	170	No harvest	170	1							170	58.8	1.89
Class III streams	100	No harvest	100	1							100	45.6	0.86
Effective Buffer Area Index												**127.1**	**4.22**
Alternative 1 (Half of FEMAT)													
Class I streams	170	No harvest	170	1							170	22.7	0.73
Class II streams	85	No harvest	85	1							85	58.8	0.95
Class III streams	50	No harvest	50	1							50	45.6	0.43
Old Growth Reserves													
Class I Streams	340	No harvest	340	1							340		0.00
Class II Streams	340	No harvest	340	1							340		0.00
Class III Streams	340	No harvest	340	1							340		0.00
Effective Buffer Area Index												**127.1**	**2.11**
Alternative 2													
Class I streams	170	No harvest	30	1	Late Seral, EEZ	70	0.6				72	22.7	0.31
Class II streams													
Redwood													
<50%	130	WHR6,EEZ	30	1	Later Seral;full susp	100	0.7	EEZ, Down wood	40	0.7	128	0	0.00
>50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	Later Seral;full susp	40	0.6	124	0	0.00
Douglas Fir													
<50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	EEZ, Down wood	40	0.5	120	52.4	1.19
>50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	Later Seral;full susp	40	0.7	128	6.5	0.16
Class III streams*													
<50%	25	ELZ	25	0.35							8.75	37.6	0.06
>50%	100	EEZ	100	0.4							40	8	0.06
Reserve Streams													
Class I	340	No harvest	340	1							340	0	0.00
Class II	340	No harvest	340	1							340	0	0.00
Class III	340	No harvest	340	1							340	0	0.00
Effective Buffer Area Index												**127.2**	**1.78**

Table I-1. Equivalent Buffer Area Analysis

Class I streams	Base width (ft)	Palco Lands Band 1 Practice	Width of Practice	Coefficient*	Band 2 Practice	Width of Practice	Coefficient*	Band 3 Practice	Width of Practice	Coefficient*	Effective Buffer Index	Stream Miles	Area Index (mi2)
Alternative 3													
Class I streams	340	No harvest	100	1	WHR6	240	0.7				268	16.63	0.84
Class II streams	170	No harvest	75	1	WHR6	95	0.7				141.5	30.49	0.82
Class III streams	100	No harvest	25	1	WHR6	75	0.7				77.5	23.03	0.34
Reserve Streams													
Class I	340	No harvest	340	1							340	5.99	0.39
Class II	340	No harvest	340	1							340	28.25	1.82
Class III	340	No harvest	340	1							340	22.54	1.45
Effective Buffer Area Index												**126.9**	**5.66**
Alternative 4													
Class I streams	170	No harvest	30	1	Late Seral, EEZ	70	0.7				79	22.7	0.34
Class II streams													
Redwood													
<50%	130	WHR6,EEZ	30	1	Later Seral;full susp	100	0.7	EEZ, Down wood	40	0.5	120	0	0.00
>50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	Later Seral;full susp	40	0.7	128	0	0.00
Douglas Fir													
<50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	EEZ, Down wood	40	0.5	120	52.4	1.19
>50%	130	No harvest	30	1	Later Seral;full susp	100	0.7	Later Seral;full susp	40	0.7	128	6.5	0.16
Class III streams*													
<50%	25	ELZ	25	0.35							8.75	37.6	0.06
>50%	100	EEZ	100	0.4							40	8	0.06
Reserve Streams													
Class I	340	No harvest	340	1							340	0	0.00
Class II	340	No harvest	340	1							340	0	0.00
Class III	340	No harvest	340	1							340	0	0.00
Effective Buffer Area Index												**127.2**	**1.81**